



Lunch Box Safety Webinar

Safety Over Sandwiches

July 19: Grain Storage Entry

Presented by Joe Mlynek, Progressive Safety Services LLC

Outline

- ▶ Review the hazards associated with entry into grain storage structures
- ▶ Discuss OSHA requirements and safe entry procedures for grain storage structures
 - OSHA 1910.272 Grain Handling
- ▶ Discuss General Procedure for Entering Grain Storage Structures – Bins, Silos, Tanks.

Entrapment Statistics (Farm/Commercial)

Year	Number of Reported Entrapments	Number of Fatalities
2015	35	14
2014	34	18
2013	33	13
2012	21	8
<i>Note: Statistics are not the final audited statistics for entrapment related fatalities.</i>		

Entrapment Statistics

- ▶ Last 7 years – 36 entrapments per year
- ▶ 80% occur on farms
- ▶ We can do more to educate both commercial and farm employees



Hazards of Grain Storage

»» Review

Prevention

- ▶ Work to identify ways to eliminate the need to enter grain storage structures (bins, silos, tanks)
- ▶ No Entry, No Risk.
 - Specialized Equipment
 - Design
 - Quality



Engulfment/Entrapment

- ▶ Engulfment – “to swallow up in”
- ▶ Entrapment – “partially submerged”



Entrapment/Engulfment

- ▶ Employees can become trapped or buried in grain in several ways:
 - Being pulled into moving or flowing grain
 - Collapse of bridged grain
 - Collapse of a vertical wall of grain (avalanche)

Flowing Grain

- ▶ Dangerous flowing situations include:
 - Grain flowing downward in a bin, silo, tank, railcar, truck, or wagon
 - Grain flowing downward toward an auger

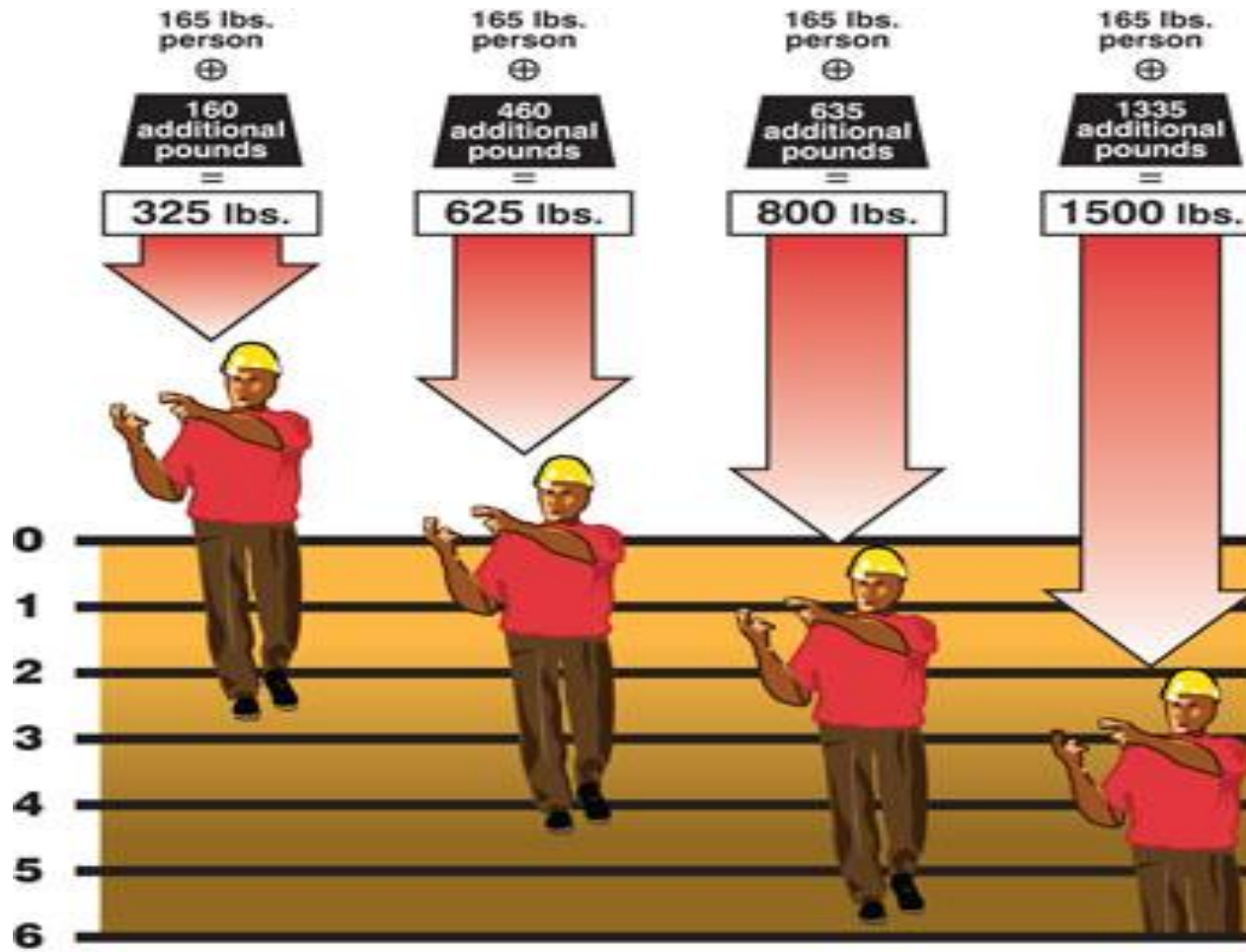


Flowing Grain

- ▶ Workers don't stand on grain, they stand in it
- ▶ A person can become helpless in a matter of seconds
- ▶ Fully engulfed in as little as 20 seconds

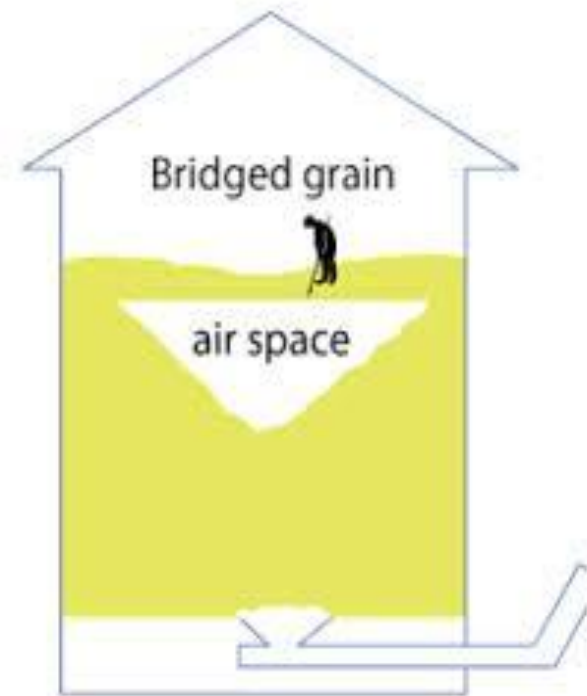


Forces on the Body



Collapse of Bridged Grain

- ▶ Grain bridges when moldy, high in moisture, or when in poor condition
- ▶ Kernels stick together forming a crust
- ▶ Hollow cavity under bridged grain can be undetectable



Safety Precautions for Bridged Grain

- ▶ Prevent bridging by storing grain in good condition
- ▶ Never enter bins while grain is being reclaimed
- ▶ Follow documented entry procedures and use required retrieval or restraint equipment and PPE

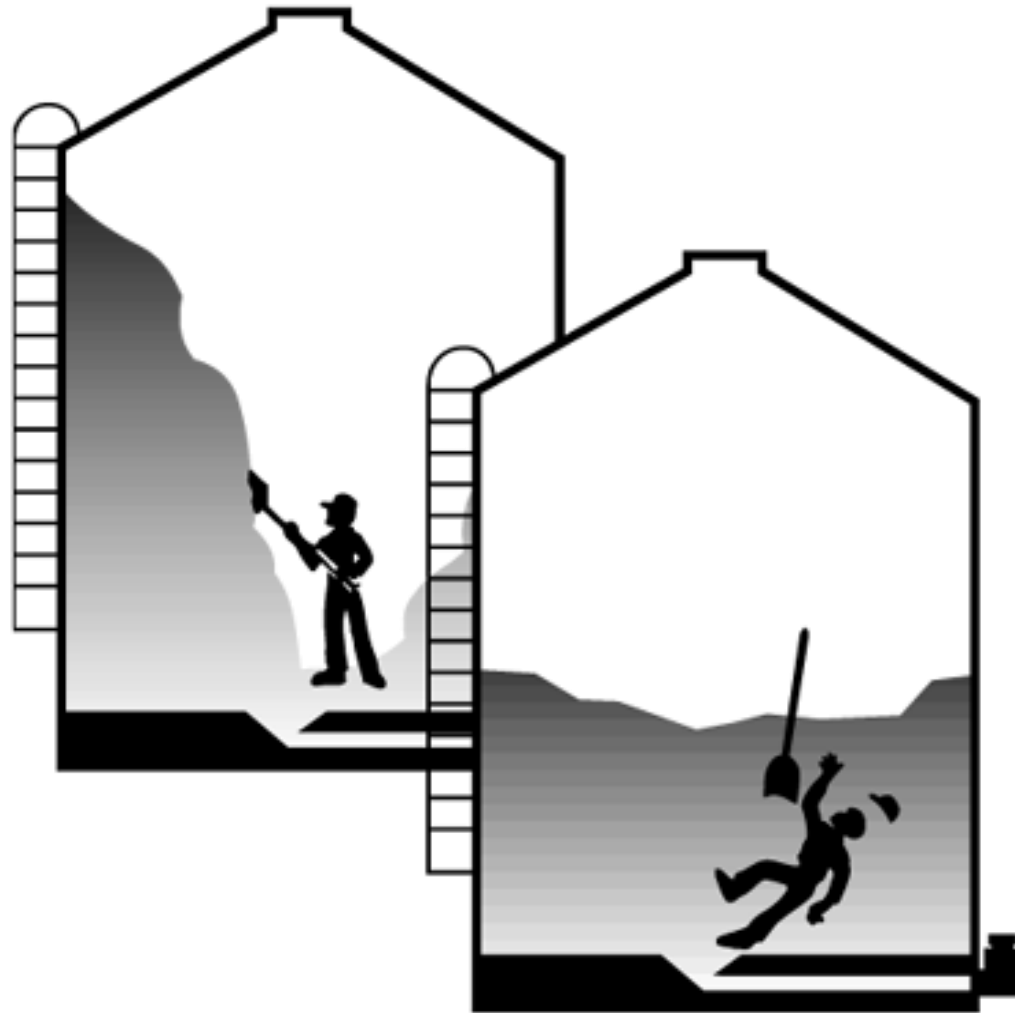
Collapse of a Vertical Mass of Grain

- ▶ Grain can set up in a large mass against a wall when it has been stored in poor condition
- ▶ The mass of grain can collapse on workers attempting remove the mass
- ▶ The “avalanche” effect can knock workers off their feet and bury them in grain



Safety Precautions

- ▶ Try to clear mass from outside the space
 - Let it dry and fall on its own
 - Flush with same commodity
 - Specialized tools
- ▶ Suspended work using retrieval equipment
- ▶ Use required, retrieval equipment, PPE, entry procedures, etc.



Angle of Repose

- ▶ The steepest angle at which a sloping surface formed of a particular loose material is stable.



Atmospheric Hazards

- ▶ Oxygen Deficiency

- Acceptable Range: 19.5% to 23.5%

- ▶ Lower Explosive Limit

- $<10\%$

Symptoms of Oxygen Deficiency

- ▶ 12–16% – Increased breathing, elevated heart rate, impaired coordination
- ▶ 10–14% – Faulty judgment, poor muscle coordination
- ▶ 6–10% – Nausea, vomiting, unconscious, unable to move
- ▶ < 6% – Difficulty breathing, death



Atmospheric Hazards

- ▶ Atmospheric Concentrations of Substances for which a PEL is published:
 - Carbon Monoxide (CO)
 - = < 50 ppm (OSHA)
 - = < 35 ppm (NIOSH REL)
 - IDLH = 1200 ppm (NIOSH)
 - Phosphine (PH₃)
 - = < 0.3 ppm (OSHA/NIOSH)
 - IDLH = 50 PPM (NIOSH REL)
- ▶ Combustible Dust (obscures vision at 5 feet or less)



Other Hazards:

- ▶ Combustible Dust (Class II Environment)
- ▶ Falls
- ▶ Extreme Temperatures
- ▶ Respiratory – Dust
- ▶ Mechanical Hazards
 - Sweep augers
 - Sub –floor augers



Requirements for Entry into Grain Storage Structures

»» Bins, Silos, Tanks, Flat Storage
per OSHA 1910.272.

Grain Storage Structures

▶ 1910.272 (g) Requirements:

- Apply to employee entry into bins, silos, tanks, and other grain storage structures.
- Exception – “Entry through unrestricted ground level openings into **flat storage structures** where there are no toxicity, flammability, oxygen deficiency, or other atmospheric hazards is covered under paragraph (h)”

Unrestricted – employees can enter by stepping, walking, or driving through the openings.

OSHA 29 CFR 1910.146

- ▶ Standard outlines all requirements for confined space entry.
- ▶ “29 CFR 1910.272 takes precedence over the permit required confined space standard for the hazards it addresses” per 2005 LOI.”
- ▶ Many companies choose to consolidate confined spaces and grain storage structures into one program or maintain separate programs.

Permits

- ▶ “Issue a permit before entering bins, silos, or tanks.”
- ▶ "Permit" means the written certification by the employer authorizing employees to perform identified work operations subject to specified precautions.
- ▶ Exception: “Permit is not required if the employer’s representative (who would authorize the permit) is present during the entire operation.”
- ▶ Best Practice: use a permit system regardless of who is part of the entry team.

CONFINED SPACE ENTRY PERMIT									
On page 1 of 2									
Location:					Type of Space:				
Reason for Entry:									
Atmospheric Hazards: <input type="checkbox"/> Oxygen Deficiency <input type="checkbox"/> Combustible gas <input type="checkbox"/> Toxic substances									
Physical Hazards: <input type="checkbox"/> Mechanical <input type="checkbox"/> Electrical <input type="checkbox"/> Thermal <input type="checkbox"/> Chemical <input type="checkbox"/> Other _____									
Hazard Controls: <input type="checkbox"/> Ventilation <input type="checkbox"/> Lockout/Tagout <input type="checkbox"/> Personal Protective Equipment <input type="checkbox"/> Other _____									
Beginning Date:		Beginning Time:		Ending Date:		Ending Time:		Valid For:	
Authorized Personnel:									
Primary Name with Dept./Shop or Company:					Secondary Name with Dept./Shop or Company:				
Required Equipment:									
Communication Methods with Outside: <input type="checkbox"/> None <input type="checkbox"/> Radio <input type="checkbox"/> Phone <input type="checkbox"/> Visual <input type="checkbox"/> Air signals <input type="checkbox"/> Other _____									
Communication Methods to Contact Emergency Services: <input type="checkbox"/> None <input type="checkbox"/> Radio <input type="checkbox"/> Other _____									
Personal Protective Equipment: <input type="checkbox"/> No entry <input type="checkbox"/> Eye face shield <input type="checkbox"/> Hard hat <input type="checkbox"/> Fall and restraint system <input type="checkbox"/> Hand and foot protection <input type="checkbox"/> Hearing protection <input type="checkbox"/> Other _____									
Hazard Controls: <input type="checkbox"/> Hot tag <input type="checkbox"/> Lockout/Tagout <input type="checkbox"/> Other _____									
Traffic Control: <input type="checkbox"/> None <input type="checkbox"/> Other _____									
Atmospheric Testing:									
Type of Gas Monitor:		Date of Last Calibration:							
Area	Atmospheric Entry Conditions	1st	2nd	3rd	4th	5th	6th	7th	8th
Oxygen	19.5-21.0%								
Combustible Gas	Below 10% LEL								
Carbon Monoxide	0-25 ppm								
Initials and Signatures:									
Approvers:									
Entry Supervisor (Print): _____ (Sign): _____									
I warrant the responsibility of Entry Supervisor is stated: _____ at _____									
Entry Supervisor (Print): _____ (Sign): _____									
The Confined Space Entry Permit has been created because: _____									
Entry Supervisor (Print): _____ (Sign): _____									
Comments:									

Permit

- ▶ “The permit must be kept on file until completion of entry operations.”
 - Best Practice: permits on file for at least one year



Permit

- ▶ Must certify that the following precautions are taken prior to entry:
 - “All mechanical, hydraulic, and pneumatic equipment which presents a danger to employees inside grain structures must be de-energized, and shall be disconnected, locked-out and tagged, blocked off, or otherwise prevented from operating by other equally effective means.”
 - Sweep Augers – “10 Sweep Auger Safety Principles”

Precautions

- ▶ The atmosphere must be tested for the presence of:
 - “Combustible gases and vapors when there is reason to believe that they may be present;”
 - “Toxic agents when there is reason to believe that they may be present (i.e. phosphine, carbon monoxide, etc.)”
 - Oxygen unless there is
 - “continuous natural air movement or;”
 - “continuous forced air ventilation before and during the entry.”
 - Best Practice – Always test atmosphere prior to entry.



Precautions

- ▶ Ventilation shall be provided when;
 - “oxygen is less than 19.5% “
 - “combustible gas or vapor is in excess of 10% of the lower flammable limit, or”
 - “toxic agents are present at levels in excess of the PEL (i.e. phosphine, carbon monoxide, etc.).”

- ▶ “Ventilation shall be provided until the unsafe condition(s) are eliminated.”

- ▶ “Ventilation shall be continued as long as there is a possibility of recurrence of an unsafe condition while in the bin.”

Precautions

- ▶ “If toxicity or oxygen deficiency cannot be eliminated by ventilation, employees shall wear an appropriate respirator.”



Precautions

- ▶ “Walking Down Grain or similar practices where an employee walks on grain to make it flow within or out from a grain storage structure is prohibited or where an employee is on moving grain are prohibited”



Precautions

- ▶ A body harness or boatswain's chair attached to a lifeline are required when:
 - “An employee enters a grain storage structure from a level **at or above** the level of grain products” or
 - “An employee walks or stands on or in stored grain at a depth which poses an engulfment hazard.”



Lifelines

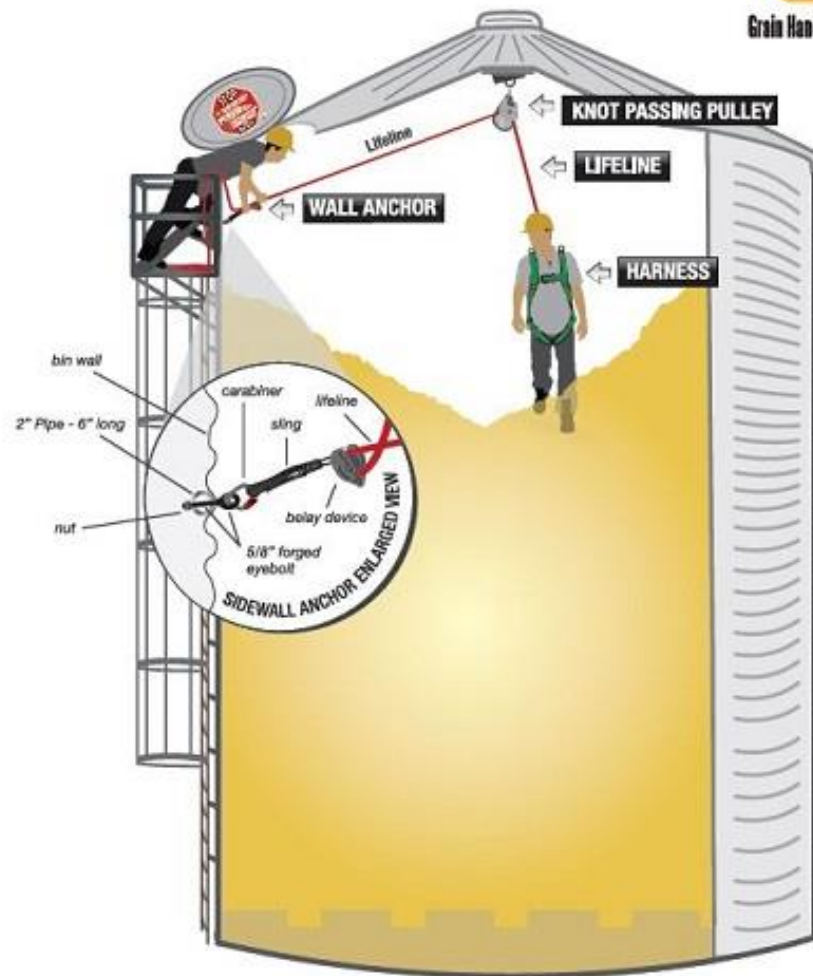
▶ The lifeline:

- “Must be positioned and of sufficient length to prevent the employee from sinking further than waist deep in grain.”
- *Exception “Where the employer can demonstrate that the protection required are not feasible or creates a greater hazard the employer can provide an alternative means of protection against sinking further than waist deep in grain.”*

Lifeline System Set-up



Grain Handling Safety Coalition



A sidewall anchor is NEVER attached to any part of the inside bin ladder.
The inside bin ladder was omitted from this drawing for illustrative purposes.

www.grainsafety.org

Note: Figures above are for detailed reference ONLY and are NOT drawn to scale.
The bin access ladder, cage, platform, roof and other structural elements are for illustrative purposes ONLY and as drawn may not comply fully with OSHA standards or have detail.

Lifelines

- ▶ “When the employee is standing or walking on a surface which the employer demonstrates is free of engulfment hazards, the lifeline or alternative means can be disconnected or removed.”
- ▶ Note: Always follow your Company's requirements.

Precautions

- ▶ “An observer equipped to provide assistance needs to be stationed outside of the bin, silo, or tank.”
- ▶ “Communications shall be maintained between the observer and employee entering the bin, silo, or tank.”
 - “voice”
 - “visual”
 - “signal line”



Precautions

- ▶ Observer must be trained in:
 - “Rescue procedures”
 - “Notification methods for obtaining additional assistance”



Precautions

- ▶ “Employer shall provide equipment for rescue operations which is specifically suited for the bin, silo, or tank being entered.”



Precautions

- ▶ “Employees shall not enter bins underneath bridging conditions, or where buildup of grain products on the sides could fall and bury them.”



Entry into Flat Storage Structures

»» Requirements

Flat Storage Structures

► Flat storage structure" means:

- “grain storage building or structure that will not empty completely by gravity;”
- “has an unrestricted ground level opening for entry;”
- “must be entered to reclaim the residual grain using powered equipment or manual means.”



Precautions

- ▶ “Each employee who stands on or in stored grain where the depth poses an engulfment hazard will be equipped with”:
 - “Lifeline”
 - “Alternate means which the employer demonstrates will prevent the employee from sinking further than waist deep into the grain.”



Precautions

- ▶ “When the employee is standing or walking on the surface which the employer demonstrates is free of engulfment hazards the lifeline or alternate means may be disconnected or removed.”



Precautions

- ▶ “Whenever an employee walks or stand on or in stored grain or grain products at a depth which poses engulfment hazards:”
 - “All equipment that presents a danger to the employee shall be de-energized,”
 - “Disconnected and locked/tagged, blocked off, or otherwise prevented from operating by other equally effective means or methods.”

Precautions

- ▶ Walking down grain is prohibited.
- ▶ “No employee shall be permitted to enter under a bridging condition or where an accumulation of grain on the sides or elsewhere could fall or engulf the employee.”

Training

- ▶ Annual
- ▶ Should include:
 - Hazards of Grain Storage
 - Atmospheric monitor operation
 - Use of proper PPE
 - Rescue Procedures
 - Roles of Observer and Entrant
 - Use of specialized equipment – retrieval equipment, etc.
 - Ventilation techniques
 - Entry Procedures
 - Isolation Procedures

Grain Storage Structure Entry

»» Responsibilities

Duties and Responsibilities

- ▶ Entrant
- ▶ Observer/Attendant
- ▶ Entry Supervisor



Entrant Responsibilities

- ▶ Take an active role in evaluating the structure.
- ▶ Know the hazards that may be faced.
- ▶ Use all required equipment.
- ▶ Follow all safety rules and procedures that apply to the job.
- ▶ Alert attendant/observer when a dangerous situation is recognized.
- ▶ Immediately exit the structure when attendant/observer issues an evacuation order.
- ▶ Remove all tools prior to completion of the entry.

Observer/Attendant

- ▶ The employee who remains outside the structure.



Responsibilities

- ▶ Know the hazards faced.
- ▶ Remain in the immediate area of the entry.
- ▶ Control access.
- ▶ Maintain communication with entrants.
- ▶ Order evacuation:
 - Behavioral effects of hazard exposure.
 - Situation outside structure could endanger entrants.
 - If attendant cannot for any reason perform duties.
- ▶ Perform non-entry rescue if needed.

(Continued)

- ▶ Summon emergency assistance as needed. Must have a means of communication:
 - Radio
 - Cell phone
 - Phone in close proximity
- ▶ Assess hazards in and around the structure, and take action when they pose risk to the entrant(s).
- ▶ Keep records of the work (atmospheric monitoring results, personnel entry/exit, etc.).

Entry Supervisor

- ▶ The employee responsible for coordinating entry.
- ▶ When possible should be the role of a foreman, supervisor, operations manager or experienced employee.

Responsibilities

- ▶ Know hazards faced with entry.
- ▶ Ensure permit and documentation filled out.
- ▶ Ensure atmospheric testing performed.
- ▶ Ensure the structure is isolated.
- ▶ Ensure all employees trained.
- ▶ Verify rescue services available.
- ▶ Terminate permit upon completion of entry.
- ▶ File permit

General Entry Procedure:

- 1) Notify affected persons of the entry
- 2) Inspect and set up all equipment
- 3) Assign roles to entry team
- 4) Secure area around the structure
- 5) Isolate the Structure
- 6) Ventilate (if applicable)
- 7) Calibrate gas monitor and perform pre-atmospheric testing
- 8) Complete permit
- 9) Enter the structure
- 10) Cancel the permit and file with supervisor

Notify Affected Persons

- ▶ Notify persons in the immediate area and management of the entry.
- ▶ Review isolation and lockout procedures to be used.
- ▶ Communicate the time frame for the entry.



Inspect/Set-Up All Equipment

- ▶ Fall protection/retrieval equipment
- ▶ Intrinsically safe lighting/equipment
- ▶ Calibrate/Bump Test Air monitor
- ▶ Personal protective equipment.



Assign Entry Roles to the Team

- ▶ Entry Supervisor
- ▶ Entrant(s)
- ▶ Attendant/Observer(s)

**REMINDER ALL PERSONS INVOLVED MUST
COMPLETE REQUIRED TRAINING!!!!**

Secure the Area Adjacent to the Entry

- ▶ Restrict access to the immediate area prior to, during and after entry
 - Non-essential personnel
 - Traffic
- ▶ Remove obstacles that may get in the way of entry or potential rescue operations:
 - Vehicles
 - Debris
 - Un-needed Equipment



Isolate the Structure from all Hazards

- ▶ **Close and Isolate Systems**
 - Lock and Tag
 - Blank/In-Flow
 - Communicate with Control Room
- ▶ **Empty the Space**
 - Remove as much of the contents as possible prior to entry
- ▶ **Lockout/Tagout Equipment**
 - Augers
 - Moving equipment



Test the Atmosphere

▶ In this order:

- **Check for Oxygen Content:**
 - At least 19.5% and less than 23.5%
- **Check for Combustibles:**
 - Less than 10% of the LEL
- **Check for Toxic Gases:**
 - Carbon monoxide
 - Hydrogen Sulfide (pits, tunnels, etc.)
 - Phosphine (fumigation)



Ventilate the Space

- ▶ Continuous ventilation required if:
 - Initial atmospheric tests are not acceptable.
 - Natural ventilation is not adequate.
 - Chemicals are being introduced into the structure for cleaning, maintenance or other purposes.
- ▶ Must not enter structure until ventilation has eliminated the hazardous atmosphere.
- ▶ Air supply from a clean source.



Atmosphere Testing Shall Be Performed:

- ▶ Prior to every entry when the structure is vacant;
 - after breaks
- ▶ Before and after ventilation
- ▶ Continually throughout the entry



Air Monitors

- ▶ Monitor may have a pump or aspirator, tubing or wand to draw air to the monitor (remote sampling).
- ▶ Monitors are equipped with a peak/low function/latching features (top entry):
 - Allows user to measure different levels of the structure
 - Best used for spaces of greater depth
 - The monitor will save the peak and low readings for the gases indicated

Air Monitors

- ▶ Make sure that monitor has been calibrated according to manufacturer recommendations.
- ▶ Make sure monitor rated for Class II Division 1 Group G environments.



Complete Entry Permit

- ▶ Permit must be correctly and completely filled out prior to entry
- ▶ Permit duration may not exceed the time required to complete the assigned work
- ▶ Entry is not allowed without a valid permit
- ▶ Keep on file for one year



Enter the structure and Proceed with work:

- ▶ An attendant/observer shall remain near the entrance for the duration of the work
- ▶ The attendant/observer shall ensure that the permit is up to date with current entrants
- ▶ The attendant/observer shall maintain the permit for the duration of the work

When the Work is Done:

- ▶ Remove all personnel, tools, and debris from the space
- ▶ Close the space
- ▶ Cancel the permit
- ▶ Review the job, any problems, etc.
- ▶ Communicate issues to Management

Wrap-Up

- ▶ Supervisor Talking Points
- ▶ Quiz
- ▶ Grainentrapmentprevention.com

- ▶ This presentation was developed to give general safety information on grain bin and confined space entry. Progressive Safety Services LLC (Progressive Safety) does not make any representation or warranty as to the accuracy or completeness of the information in this presentation. Refrain from doing any act or omission that are reasonably foreseeable that a particular other person (or class of persons) is likely to suffer damage or loss as a result of the act or omission. Progressive Safety is excluded from liability for negligence for both personal injury and damage to property. The information within this presentation is general. It does not constitute and should not be relied on as legal advice. Progressive Safety Services LLC tries to ensure that the content of this presentation is accurate, adequate or complete, it does not represent or warrant or its accuracy, adequacy of completeness.



Questions?

Joe Mlynek CSP, OHST

joe@safetymadesimple.com

joe.mlynek@progressivesafety.us

www.safetymadesimple.com

www.progressivesafety.us

